Comments

E-0043/042, EM-0217/042, EM-0218/042, L-0056/042, LM-0017/042, LM-0018/042

The HSW EIS should analyze the uncertainty of its analysis. Merely discussing the parametric sensitivity of the models is not a substitute for uncertainty analysis. Further, the large changes in results between the first 25 model runs and the runs DOE chose to use in support of the HSW EIS add to the uncertainty and should be disclosed.

L-0041/043

The existing groundwater model should be upgraded to reflect the inverse U-Code analysis of the groundwater model, which showed: a) large movements of water through the fractured basalt between the confined and unconfined aquifers, and b) large inputs of water from the confined aquifer to the unconfined aquifer from the various discontinuities across the site, including the Umtanum, Yakima and Rattlesnake ridges.

L-0044/033

CRD, p. 3.90 (Re: Comment # 76) Although a rationale is provided for "best estimate" of Kd values, the associated uncertainty should be described.

Response

DOE has embarked on an initiative to strengthen the technical defensibility of the site-wide groundwater flow and contaminant transport model. The initiative also involves developing a more robust capability to incorporate uncertainty into the models. One aspect of the initiative is developing and using a three-dimensional transient inverse model approach to estimate the hydraulic conductivities, specific yields, and other site-wide scale parameters, including their uncertainties. This is done by using data on the transient behavior of the unconfined aquifer system resulting from Hanford Site waste management practices since 1943.

The initial baseline transient inverse calibration effort (Cole et al. 2001b), which provides the basis for the model used in this EIS, substantially improved the capability of the baseline model over the prior model documented in Cole et al. (1997) in simulating historical trends in water-table changes over the entire site for the entire 1943-1996 period of calibration. The most notable improvements were in the historical trends of water table changes and mound building observed near major discharge facilities in the 200 West Area. The resulting baseline inversed model used in the HSW EIS assumes that the underlying basalt system provides an impermeable base to the unconfined aquifer. The inverse modeling analysis acknowledges the potential importance of the underlying basalt system to the overall flow system, and that quantification of this basalt leakage cannot be directly measured and is therefore uncertain.

More recent inverse modeling efforts (Vermeul et al. 2001) investigated the effects of inter-communication between the unconfined aquifer and the underlying upper basalt confined aquifer to determine whether the inclusion of basalt leakage could improve parameter estimates and results, and the overall model fit. Incorporating basalt leakage in the site-wide model was accomplished by adding the following intercommunication mechanisms to the baseline inverse model in steps designed to investigate each feature's sensitivity and relationship with other estimated parameters: (1) hydraulic head dependent, areal distributed leakage through the basalt confining layer; (2) increased leakage at an erosional window near Gable Mountain/Gable Butte; (3) increased leakage at a smaller erosional features near B-Pond; and (4) increased leakage along two fault zones.

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It has been suggested in a comment on the HSW EIS that "the total volume of water upwelling through the basalt is approximately equal to the input from surface water infiltration, and that surface water infiltration is two to three times as large as had been previously believed." This is not consistent with the results of the model analysis. The time-weighted average basalt leakage flux contributing to aquifer recharge is only about 10 percent of flux associated with natural recharge (Vermeul et al. 2001). The flux for basalt interaction, which is dominated by areal leakage, ranged from 1,000 to 2,000 m3/d over the simulation period. The flux attributable to natural recharge over the modeled region is on the order of 25,000 m3./day.

Graphical and statistic comparisons illustrate that, over the entire prediction period, a slight measurable improvement in overall model fit was realized for the alternative conceptual model (ACM-1) with basalt interaction over that observed for the baseline inverse model. However, the most noteworthy improvements in the ACM-1 transient inverse calibrated model are not associated with overall model fit, but with incorporation of a more realistic conceptual model

The HSW EIS evaluates impacts using two alternative flow model conditions and a range of assumed flow conditions. DOE has used of this type of approach in previous analyses and intends to continue evaluation of additional alternative conceptual models for use in planned site-wide assessments such as the Composite Analysis. The baseline model was selected for use in the HSW EIS after it produced reasonable results of tritium plume transport when compared to historical tritium plume observations and interpretations in its application in the SAC Initial Assessment (Bryce et al. 2002). The ability of the alternative conceptual model incorporating intercommunication with the basalt system to simulate past tritium plume behavior is currently under evaluation. Comparisons of pre-Hanford water table conditions using the baseline model, and the alternative conceptual model with basalt interaction, suggest very similar flow conditions, and provide a general indication of expected post-operational Hanford water table conditions. See Volume II Appendix G.

An expanded discussion of uncertainties associated with the HSW EIS impact analyses is included in Volume I Section 3.5.

Comments

L-0041/032

The uncertainty in the groundwater flow directions (G.1.5.2) will dramatically increase the number of groundwater monitoring wells required to verify the impact the burial grounds will have on the underlying aquifer. Additionally, Oregon questions the assumption that basalt is impermeable. This assumption should be verified through additional characterization and continued monitoring. Previous analysis and estimates by Pacific Northwest National Laboratory (PNNL) of the aquifer indicate that water is moving through the basalt. PNNL's inverse U-Code analysis indicated that in most locations water is up-welling through the fractured basalt, but that in some locations the overlying water table is infiltrating downward, into the confined basalt aquifer. The inverse U-Code analysis indicates that the total volume of water upwelling through the basalt is approximately equal to the input from surface water infiltration, and that surface water infiltration is two to three times as large as had been previously believed. The EIS needs to incorporate these facts in its analyses or discuss why they are not being considered.

Response

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Groundwater monitoring is conducted according to TPA requirements, the Hanford Dangerous Waste Management permit, and DOE Orders. Groundwater monitoring will be expanded as necessary according to agreements between DOE and regulatory agencies to support future waste management operations.

Comments

L-0055/019

DOE is assuming the basalt aquifer is impermeable. Hydraulically, this is incorrect. The Columbia River basalt group has shown to have both vertical and horizontal permeability. As an example, pumping out of the basalt aquifers in the Yakima Valley have resulted in an increase in the downward gradient of the shallow aquifers where there used to be recharge form the basalt. The hydraulic conductivity may at times be low, but with the basalt aquifer covering such a large area, this could be significant. In addition, some of the hydraulic gradients observed around Hanford can only be explained by discharge out of the basalt aquifers. DOE has also ignored lateral transport of waters throughout the burial grounds. The water could move laterally beneath the caps and infiltrate these burial grounds.

L-0055/025

Waste site inventories, both in terms of chemical and radioactive contaminates, are not precisely known for many of the solid and liquid waste sites present on the Central Plateau. Although the overall quantities of radionuclides generated at the Hanford Site are relatively well known, the actual amount in specific waste sites is uncertain. This uncertainty is very important. Various waste types could get into the ground water from sources, routes, and methods unknown to Hanford DOE. Thus the levels and rates of contamination could be faster or slower depending on many conditions such as geology, chemistry, precipitation, ground water gradient, location, etc.

Response

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Lateral water movement, as a phenomenon that might affect contaminant transport, has not been evaluated in the HSW EIS. This is attributable to an absence of field observations of natural recharge events causing lateral movement of water under the solid waste burials. It is possible that liquid discharge waste sites, sewer tile fields, and unplanned releases located immediately adjacent to solid waste burial grounds could create higher moisture contents in and above some strata within the vadose zone profile, and that such water could move laterally. However, such events and effects would be local and short term (operational era), relative to the larger scale and longer term risk assessments (thousands of years).

For the SAC, the solid waste burial grounds have been simulated as aggregated solid wastes with a one-dimensional model that did not assume movement of water laterally under the burial grounds. Multidimensional analyses are conducted as part of the Solid Waste Burial Ground Performance Assessments. These analyses are based on a uniform recharge rate over the disposal region, and may project a buildup of moisture in and above some strata in the geohydrologic profile before drainage occurs. The performance assessment analyses do not indicate lateral migration. (Wood et al. 1995, Wood et al. 1996).

An expanded discussion of uncertainties associated with the HSW EIS impact analyses is included in Volume I Section 3.5.

Comments

E-0047/005

The EIS is not based on adequate data regarding both on-site and off-site waste. For example, DOE lacks accurate data on the character of LLW, MLLW and ILAW despite the fact the EIS purports to assess the effects of managing these waste types at Hanford.

Question # 2- Does DOE acknowledge that it lacks accurate data about the characterization of the host of waste types covered by the EIS? If not, please explain. If so, please explain how absent accurate characterization data DOE can accurately assess the potential effects of managing this waste?

The EIS similarly fails to adequately consider the nature and character of the waste that would be generated from cleanup actions at Hanford.

Question # 3 - Does DOE recognize that it lacks significant information about the nature and character of waste that will be generated from proposed and ongoing cleanup actions at Hanford?

As specifically recognized by the HAB, the EIS does not adequately consider the effects of managing numerous wastes that should be considered in the EIS including:

1. Residual waste DOE proposes to leave in tanks,
2. Leaked tank wastes,
3. Wastes in related ancillary equipment and piping,
4. Hazardous or mixed wastes buried in the low-level burial grounds, and releases from the burial grounds;
5. Transuranic wastes in burial grounds,
6. Waste currently uncharacterized and stored in the PUREX tunnels, and
7. K-Basins sludges.

The draft EIS cannot ignore the potential cumulative effects from past, present and reasonably foreseeable actions that may and in fact are being cause caused by these waste types as required by NEPA and its implementing regulations. 40 C.F.R § 1508.25.

The draft EIS also appears inconsistent with DOE's previous commitment to treat all TRU waste as potentially mixed waste unless characterization supports that such waste is not mixed.

Question #4- On what basis does the EIS deviate from DOE's previous recognition that it is prudent to assume TRU waste is mixed unless actual characterization supports otherwise?

Question # 5- Absent assuming that all uncharacterized TRU waste is mixed waste, does DOE acknowledge that it could be failing to consider the potential effects of TRU waste that has a high likelihood of being mixed with hazardous waste?

Response

DOE has embarked on an initiative to strengthen the technical defensibility of the site-wide groundwater flow and contaminant transport model. The initiative also involves developing a more robust capability to incorporate uncertainty into the models. One aspect of the initiative is developing and using a three-dimensional transient inverse model approach to estimate the hydraulic conductivities, specific yields, and other site-wide scale parameters, including their uncertainties. This is done by using data on the transient behavior of the unconfined aquifer system resulting from Hanford Site waste management practices since 1943.

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Hazardous chemicals in MLLW have been characterized and documented since the implementation of RCRA at DOE facilities beginning in 1987. MLLW currently in storage, and MLLW that may be received in the future, would be treated to applicable state or federal standards for land disposal. Therefore, disposal of that waste is not expected to present a hazard over the long term because the hazardous constituents would either be destroyed or stabilized by the treatment. Inventories of hazardous materials in stored and forecast waste are either very small, or consist of materials with low mobility. See Volume II Appendixes F and G.

Inventories of hazardous chemicals in waste were not generally maintained by industries in the United States prior to the implementation of RCRA. Consistent with these general practices, inventories of hazardous chemicals in radioactive waste were not required to be determined or documented before the application of RCRA to radioactive mixed waste at DOE facilities in late 1987. Wastes placed in the LLBGs before late 1987 have not been specifically characterized for hazardous chemical content, but they have been evaluated in the EIS alternatives relative to their radionuclide inventories. In addition, preliminary estimates of chemical inventories in this waste have been developed for analysis in the HSW EIS, and a summary of their potential impacts on groundwater has been added to Volume I Section 5.3 and Volume II Appendix G.

In addition, the October 23, 2003 Settlement Agreement contains proposed milestones in the M-91-03-01 Tri-Party Agreement Change Package for retrieval and characterization of suspect TRU waste retrievably stored in the Hanford LLBGs (United States of America and Ecology 2003). As part of that agreement, DOE will manage the retrievably stored LLBG waste under the following assumptions: (1) all retrievably stored suspect TRU waste in the LLBGs is potentially mixed waste; and (2) retrievably stored suspect TRU waste will be managed as mixed waste unless and until it is designated as non-mixed through the WAC 173-303 designation process.

Interactions among different types of waste that could potentially mobilize radionuclides have also been considered as part of the HSW EIS analysis. However, such interactions typically require specific chemical environments or large volumes of liquid as a mobilizing agent, neither of which are known to be present in the solid waste disposal facilities currently in use (see discussion in Volume II Appendix G). Possible effects of this type could be mitigated by selecting candidate disposal sites to avoid placing waste in locations where previous contamination exists.

Waste sites and residual soil contamination remaining at Hanford over the long term, and which are not specifically evaluated as part of the HSW EIS alternatives, have been evaluated previously as part of NEPA or CERCLA reviews. In those studies, the risks associated with older solid waste burials, tank waste residuals and leaks, and contaminated soil sites were found to be very small, even for alternatives that considered stabilization of the waste in place (DOE 1987, DOE and Ecology 1996, Bryce et al. 2002). Further evaluation of tank wastes is anticipated in the "Environmental Impact Statement for Retrieval, Treatment, and Disposal of Tank Waste and Closure of Single-Shell Tanks at the Hanford Site" (68 FR 1052). The cumulative groundwater impacts analysis in the HSW EIS also includes those wastes, as described in Volume I Section 5.14 and Volume II Appendix L.

DOE plans to characterize pre-1970 inactive burial grounds and contaminated soil sites, as well as the active LLBGs considered in the HSW EIS alternatives, under the RCRA past practice or CERCLA processes to determine whether further remedial action would be required before the facilities are closed. As part of that process, the long-term risks from these wastes would either be confirmed to be minimal, or the waste would be remediated by removal, stabilization, or other remedial actions to reduce its potential hazard. In all cases, the impacts from these previously disposed wastes would be the same for all alternative groups considered in the HSW EIS, and would not affect the comparisons of impacts among the alternatives or the decisions made regarding disposal of waste received in the future.

Impact Evaluation

An expanded discussion of uncertainties associated with the HSW EIS impact analyses is included in Volume I Section 3.5.

Comments

L-0044/042

Since there are huge differences in the inventory of the waste, based on what is in the record vs. what can be estimated using the fuel-ratio method for fission product inventories not reported on original records or prior estimates ((please see Table L.1, e.g. for Tc-99 inventory: 9.1 Ci [curie(s)] vs. 26.3 Ci)), the SAC-SW EIS should take both into consideration in one of their 25 realization analyses. The results of the comparison should be presented for comparison.

Response

Volume II Appendix L Table L.1 shows a comparison of the inventories used in the 10,000-year post-closure period System Assessment Capability initial assessment and those used elsewhere in the HSW EIS. The initial assessment inventory values are median values from a stochastic simulation of inventory estimates that are based on original records, prior inventory estimates, and a fuel-ratio method for estimating fission product inventories. To account for substantial uncertainties, a 20-fold uncertainty factor was assigned to inventories disposed from the time of Hanford startup in 1944 through 1969. That is, the inventory simulated in a single realization of the stochastic model for a waste site ranges from 1/20th to 20 times the inventory disposed during the 1944 to 1969 period. From 1970 until site closure, a two-fold uncertainty was assigned, thus simulating inventories ranging from one-half to double the estimated inventory for this period. Because only 25 realizations are employed in the stochastic simulation, only the central tendency median values are reported.

As of September 2003, sensitivity cases based on individual estimates of inventory have not been produced with the SAC. However, substantial uncertainty is captured in the SAC initial assessment representation of inventory. The substantial variability in inventory estimates seen in Volume II Appendix L Table L.1 derives from the key assumptions used to develop the SAC initial assessment and HSW EIS inventory estimates. For example, the HSW EIS inventory uses the Solid Waste Information Forecast Tool, a methodology developed and maintained at Hanford to estimate future solid waste disposals, including those from the Waste Treatment Plant (WTP). For the same estimates of future WTP disposals, the initial assessment instead relied on the Hanford Tank Waste Operation Simulator, a model of WTP waste processing and resultant waste streams. Other bases for inventory estimates and variability are noted in the Volume II Appendix L Table L.1 footnotes.